Lister Avenue is the Source of Dioxin to RM 10.9 and to the LPRSA

April 26, 2012

OVERVIEW

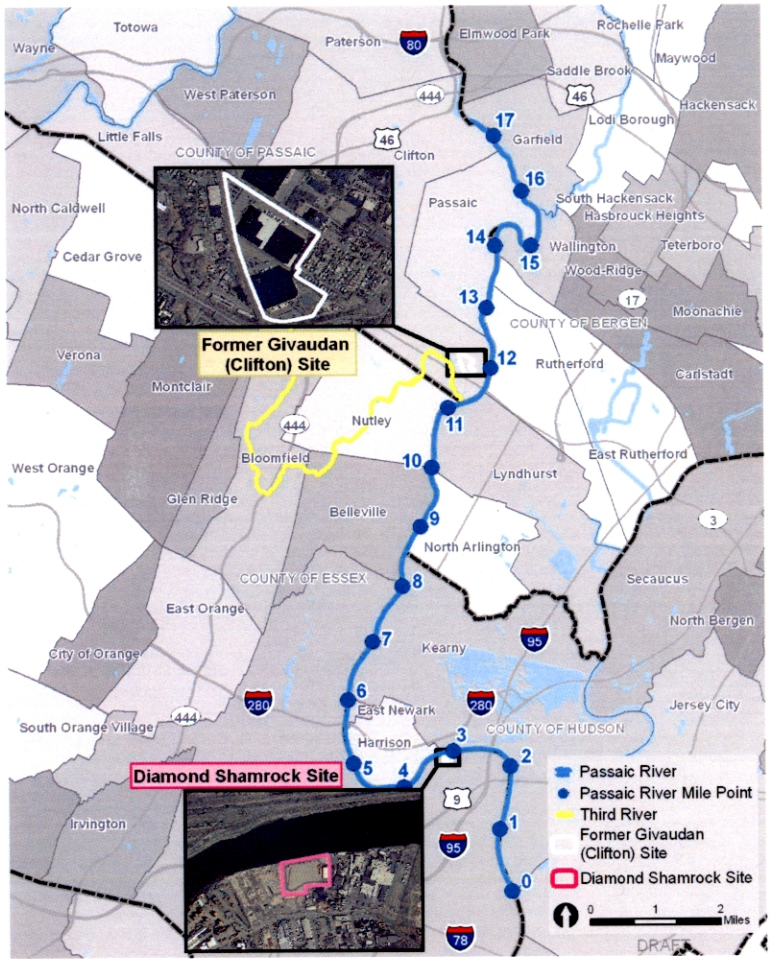
- Lister Avenue / Givaudan Comparison
  - Different Sources and Concentrations of Dioxin at Each Site
  - Different Pathways or Alleged Pathways to the LPRSA

- Assuming it is Reliable, the HCX Data Does Not Support Tierra / Maxus Position that Givaudan was the Source of Dioxin at RM 10.9

- HCX is Not a Marker For Givaudan

- Upstream Transport, Cesium Data and Dioxin/Furan Fingerprint Confirms Lister Avenue is the Source of Dioxin to the LPRSA, Including RM 10.9

Lister and Givaudan Site Locations



FOR DISCUSSION PURPOSES ONLY

Site Comparison – Products

- Lister Avenue Site
  - From approx. 1948 to1969, Lister Avenue manufactured pesticides and herbicides including DDT, pesticide grade trichlorophenol (TCP), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) and 2,4-dichlorophenpxyacetic acid (2,4-D)[1]
  - Mean reported dioxin concentration of 10-50 parts per million (ppm) in Lister Avenue's pesticide-grade TCP[2]

- Givaudan's Clifton Facility
  - Givaudan piloted TCP sometime in late 1940's (1947-49)[3]
  - Following TCP pilots, Givaudan purchased a pre-purified TCP as a feed stock to make the pharmaceutical product hexachlorophene (a/k/a G-11)[4]
  - Mean reported dioxin concentration of <1 part per billion (ppb) in pre-purified TCP purchased by Givaudan[5]

Lister Site: Production Processes

- Production of 2,4,5-TCP (Technical Grade) for over 20 years[6]
- Use of 2,4,5-TCP (Technical Grade) to manufacture 2,4,5-T Herbicide Product and Agent Orange[7]
- In 1959, Lister Avenue was advised of a two-step process by which dioxins could be eliminated, or at least reduced, in the TCP manufacturing process. Despite specific preventive recommendations, Lister Avenue made a conscious decision to run its TCP production at a higher temperature than suggested.[8]
- A government document entitled "Herbicide Stock at Gulfport, Mississippi" indicates that, of the government's stockpile of Agent Orange, the average dioxin content of the product manufactured by Lister Avenue was greater than that of the product manufactured by the four other companies whose products were stored at that location.[9]

Clifton Site: G-11® Process

- Pharmaceutical Grade Hexachlorophene (antiseptic/germicidal agent) commercial production from late -1940s to May 1984[10]
- Unintended contaminant 2,3,7,8-TCDD only present as byproduct in raw material – created during 2,4,5-TCP production, not G-11 production[11]
- Purchased *purified* TCP (pharmaceutical grade) for production of hexachlorophene (primarily from Hooker and Dow) with specifications for TCDD at undetectable levels[12]
- Givaudan rejected Lister Avenue TCP (technical grade) because of excessive contaminant level[13]

LISTER AVENUE
DIRECT PATHWAYS TO PASSAIC

Lister is the Source of TCDD to RM 10.9, the LPRSA, and the Newark Bay Complex

- Multiple Lines of Evidence Establish that the Lister Site is the Source of Dioxin and other COPCs to the LPRSA and NBC, including RM 10.9
- Prior Witness Testimony, Court Decisions and Numerous Sampling Events Leave No Doubt about Lister's Intentional Conduct and Use of Passaic to "River-ize" its Wastes

Givaudan Alleged Pathways to Passaic – Waste Water

No Evidence of Dioxin in Wastewater

- EPA Process Sample Results (1980)[14]
  - ND in samples for aqueous slurry of HCP, activated clay filter cake, and ethylene dichloride recovery solution
  - 50 ppt -140 ppt detection limit
- Sanitary Sewer (1982)[15]
  - ND in 3 samples
  - 10 ppb detection limit
- Process By-Products (1983)[16]
  - ND in samples for spent sulfuric acid, filter cake, ethylene storage tank, water from vacuum receiver, water from catch all tank, water from extracted TCP, water wash from HCP filter
  - Detection limits 0.1 ppb with the exception of filter cake (1 ppb)
- PVSC sampling (beginning in 1982)[17]
  - All samples N/D
  - 1 ppb detection limit

Givaudan Alleged Pathways to Passaic – Storm Water

No Documented Evidence of Off-Site TCDD Impacts from Storm Water

- NUS Corporation 1983 Investigation[18]
  - No TCDD detected in any of the off-site samples
  - Detection limits 0.02 ppb - 0.15 ppb
- 1987 ACO for TCDD[19]
  - "26 samples were taken and analyzed by EPA in the area surrounding the Site, all of which were analyzed as containing no TCDD contamination in concentrations of 1 ppb or more."
  - "no evidence that TCDD contamination has migrated off the Site."
- All TCDD impacted soils delineated and remediated[20]
  - Dioxin Cell Construction 1996[21]
  - NJDEP No Further Action Letter and Covenant Not to Sue 2002[22]

Clifton HCP Wastes: Properly Disposed Offsite

Givaudan managed its HCP still bottom and filter cake waste from the G-11 manufacturing process and properly disposed of the material off-site[23]

A 1984 EPA Study of HCP Manufacturing Waste Streams reported:

- "The concentration of TCDD in the [HCP] waste streams will vary considerably depending on whether the pesticide or pharmaceutical grade product is being manufactured."[24]
- Percent Distribution of TCDD in Waste Streams Associated with Pharmaceutical Grade HCP Process:[25]
  - Filter Solids – approximately 5-10%
  - Still Bottoms – approximately 80-90%
  - Wastewaters – approximately < 5%
- Based on a TCDD contaminant level of 1 ppb in the starting 2,4,5-TCP, it was estimated that:[26]
  - TCDD concentration in the filter solids would be in the range of 0.50 – 1.20 ppb;
  - TCDD found in the still bottoms would be between 1 and 2 ppb;
  - TCDD concentration in the wastewaters would be low (< 0.01 ppb).

Site Data Comparison

Lister Site

- Known, direct, intentional dioxin discharger to Passaic River
- Upland site located on Passaic at RM 3.2
- Produced Technical Grade TCP from at least 1948-1969; used pesticide grade TCP for production of Agent Orange
- **TCDD on-site soils** in tens of thousands of ppb range
- Multiple off-site discharges to surrounding area in Newark and Passaic River
- 1984 Federal NPL Site (OU-1), ongoing 5-yr reviews of TCDD containment area
- Confirmed TCDD groundwater impacts
- Principal Source of contaminants to Passaic River (OU-2) and Newark Bay (OU-3)

Clifton Site

- Alleged indirect discharger to Third River/Passaic River
- Upland site located 0.3 miles from Passaic at approx. RM 12
- Pilot production of TCP 1947-1949; used purified TCP for Hexachlorophene production until 1984
- **TCDD in soils in low ppb range localized onsite; majority non detect**
- EPA and NJDEP investigations confirm no migration of TCDD off-site
- NJ – 1987 ACO and 2002 Site-wide NFA on TCDD
- No TCDD groundwater impacts
- No confirmed TCDD link to Passaic River

HCX is Not A Marker of TCDD in Complex River Environments

- HCX is reported in background at other sites[27]
- HCX has been recently reported in the scientific literature to be present in TCP feedstock[28]*
- Chlorinated xanthenes have been reported as a byproduct of the ubiquitous xanthenes in the environment associated primarily with pulp/paper and textile/dye operation effluents[29]
- HCX has been reported in air particulates near St. Louis not associated with HCP production[30]*
- Because hexachlorophene was such a widely used consumer product, HCX could be ubiquitous in the river from multiple sources including municipal wastewater

*The literature data referenced may be unclear

HCX Reported in Feed at Centredale Site

A tiered approach to fingerprinting dioxins:
Distinguishing between an HCP manufacturing source and a barrel reconditioning facility

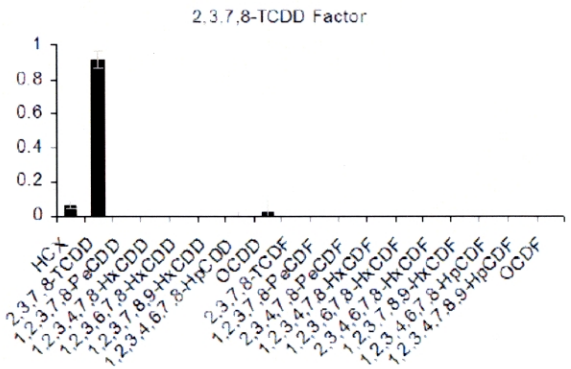
Noémi Barabás, Joseph Helfand, and Joyce Dunkin
LimnoTech
Paul Turnham, John Griffin
Exponent

SETAC 2010
Portland, OR

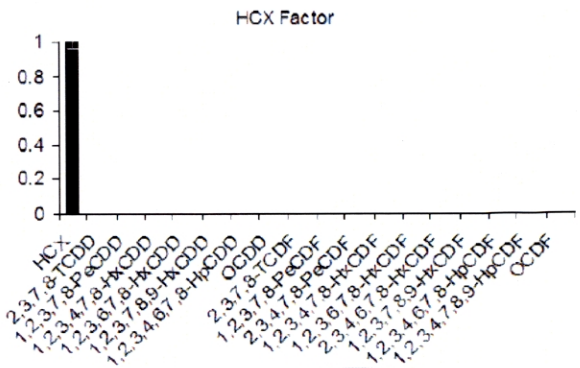
LimnoTech | Exponent

PVA Results 1

Both of these compositions are known to be typical of the HCP manufacturing process



Present in the feed, was removed in initial steps, prior to reactor.



Byproduct of HCP reaction, removed in steps after reactor.

19

TIERRA / MAXUS HAVE NOT PROVEN THAT HCX DATA FROM FSI IS RELIABLE

- Limited Body of Scientific Inquiry into HCX
- No EPA Approved Method for HCX analysis
- Tierra / Maxus spent two years on its Method Development Study (MDS) for HCX testing
- Tierra / Maxus MDS *not published or produced* to our knowledge
- Tierra / Maxus HCX analytical method *has not been reproduced* to our knowledge

Assuming Tierra / Maxus Data Is Reliable, FSI Data Is Not Comparable to HCP Sites

- Tierra / Maxus Use Times Beach and Centredale as Reference Sites for Hexachlorophene Sources of Dioxin

- Both Centredale and Times Beach Source Samples Exhibited Elevated Levels of Both Dioxin and HCX
  - Centredale: TCDD samples up to 110 ppb (J) with HCX up to 364 ppb (J) [31]
  - Times Beach: TCDD samples ranging from 46 ppm to 9,648 ppm and HCX from 127 ppm to 28,600 ppm[32]

- Tierra / Maxus Failed to Establish Similar Elevated Levels of HCX in FSI Samples from Passaic
  - Maximum HCX concentration of 1.57 ppb in 45 HCX samples (over 200 times less than maximum source concentrations at Centredale and 18 M times less than Times Beach)

- Tierra / Maxus Failed to Establish Similar Levels of Dioxin in FSI Samples
  - Maxus / Tierra is withholding its TCDD congener data at all FSI locations
  - JDG split samples showed maximum dioxin concentration of .029 ppb at RM 11.5 locations
  - JDG split samples showed maximum dioxin concentration of 27 ppb at RM 10.9 locations

Assuming Tierra / Maxus Data Is Reliable, FSI Data Shows That Givaudan Is Not The Source of TCDD At RM 10.9

- HCX concentrations not consistent with hexachlorophene manufacturing source (*see* Centredale and Times Beach)
- Very low concentrations of Dioxin at RM 11.5 alleged "source" area
- Lower concentrations of HCX in higher dioxin samples at RM 10.9 inconsistent with Tierra / Maxus hexachlorophene "source" theory
- No correlation between HCX and elevated dioxin at RM 10.9

Sample	2,3,7,8 TCDD (ppt)	HCX (ppt)
RM 11.5 "Source" Area Samples		
B-01 (0-6)	11.1	4.91
B-01 (18-24)	29.3	44.5
B-02 (0-6)	7.17	3.5
B-02 (12-18)	27.8	11.5
RM 10.9 Surface Samples		
A-02 (0-6)	27,000	65.4
A-03 (0-6)	17,300	21.3
A-03 (12-18)	6,530	64

HCX Concentrations in Passaic River vs. Centredale Superfund Site

Location	Minimum Detected (ppt)	Maximum Detected (ppt)	Median	Number Sampled	Number Detected
Passaic River (RM 10.9)	5.86	401 (J)	35.1	45	42
Passaic River (RM 11.5)	2.98 (G)	1,570	17.3	23	22
Centredale Upstream Sediment/ Floodplain	1.69	417 (J) 1,550 (1/2 DL)	135.3	28	14
Centredale Source Area	0.311	93,773 (J)	125.84	75	67

- Passaic River HCX akin to Background levels of HCX at Centredale

- Passaic River HCX data not consistent with HCX levels at Centredale Source area

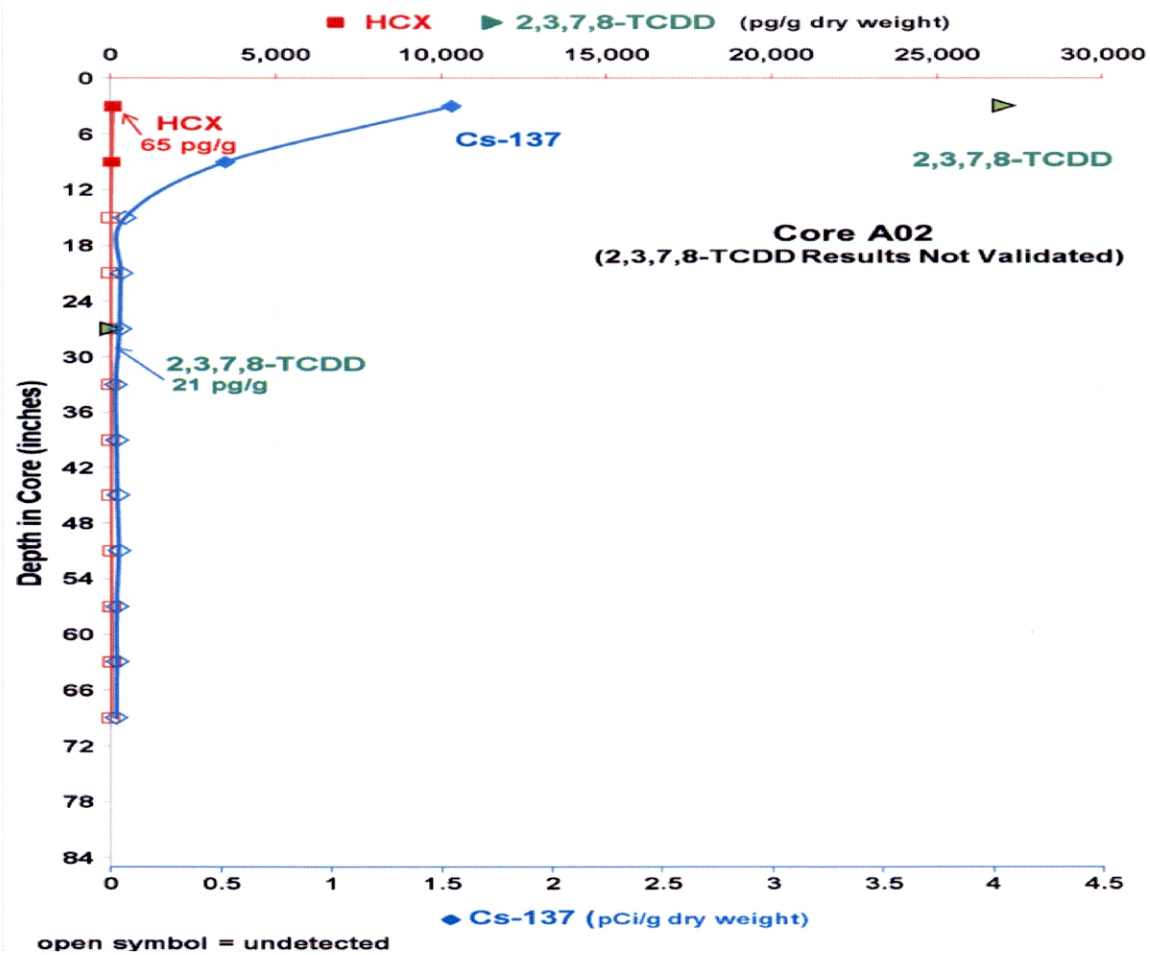
Tierra / Maxus Failed To Recognize Critical Lines of Evidence

- Cesium Data
  - Ability to date DDX, TCDD and HCX in cores
  - Important because of the different periods of operations between Lister (1946-1969 with continuing discharges into 1990's) and Givaudan (1947-1984)
- Potential For Release / Mass Balance
- Dioxin / Furan Fingerprint
  - Ability to distinguish discharges from different sources
  - Important because there is empirical data to support a different congener profile from operations and processes from Lister Avenue's pesticide-grade TCP and Givaudan's pre-purified TCP

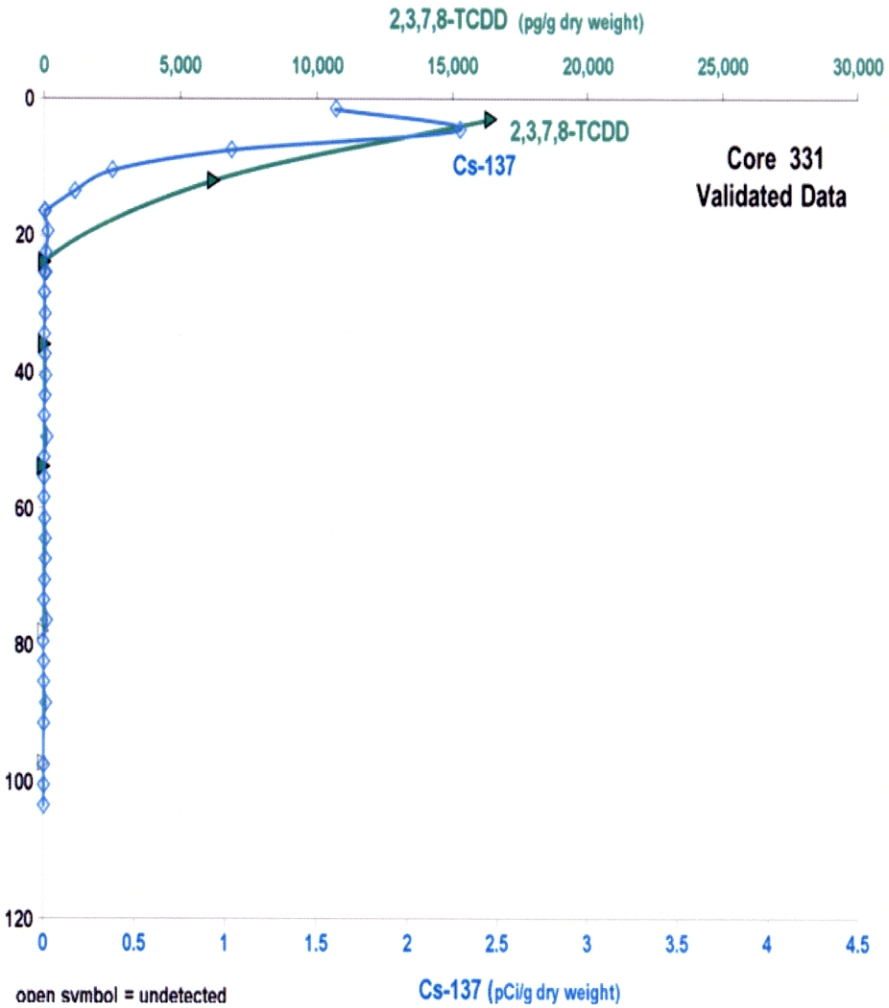
Lister Avenue and Cesium History

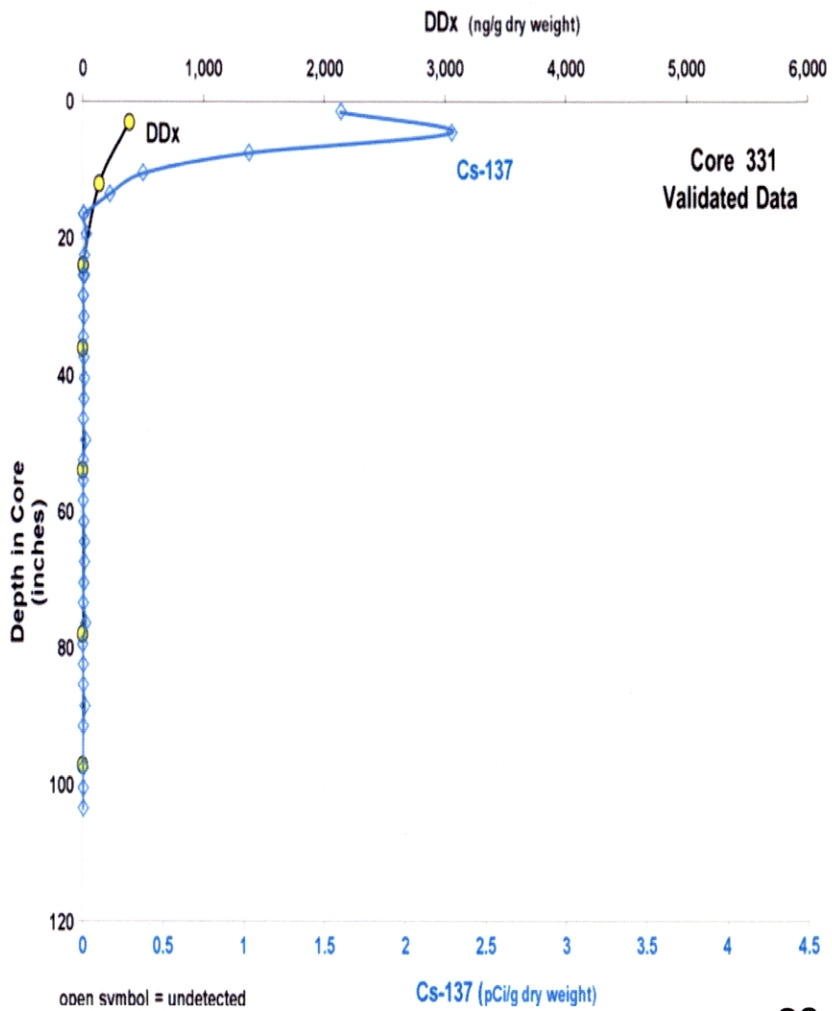
- 1948 – Lister Avenue Began Production of DDT and TCP
- 1954 – Cs-137 introduced into environment
- 1956 – Lister Avenue Connects some operations to PVSC sewer system
- 1959 – Lister Avenue Ends Production of DDT
- 1960 – Lister Avenue 2,4,5-T Manufacturing Building Explosion
- 1963 – Cs-137 Peak
- 1969 – Lister Avenue Ceased Operations

Vertical Profiles of Cesium-137, 2,3,7,8-TCDD and HCX in FSI Area A02 Core (RM 10.9)



Vertical Profiles of Cesium-137 2,3,7,8 TCDD and DDX (RM 10.9 Core 331)





Site Comparison – Mass Balance

- Lister Avenue
  - TCDD in pesticide grade 2,4,5-TCP associated manufacturing: 2 M lb/yr x 10 ppm to 50 ppm (average concentration) x 22 years of operation (1948-1969) = 440 lb to 2,200 lb of TCDD

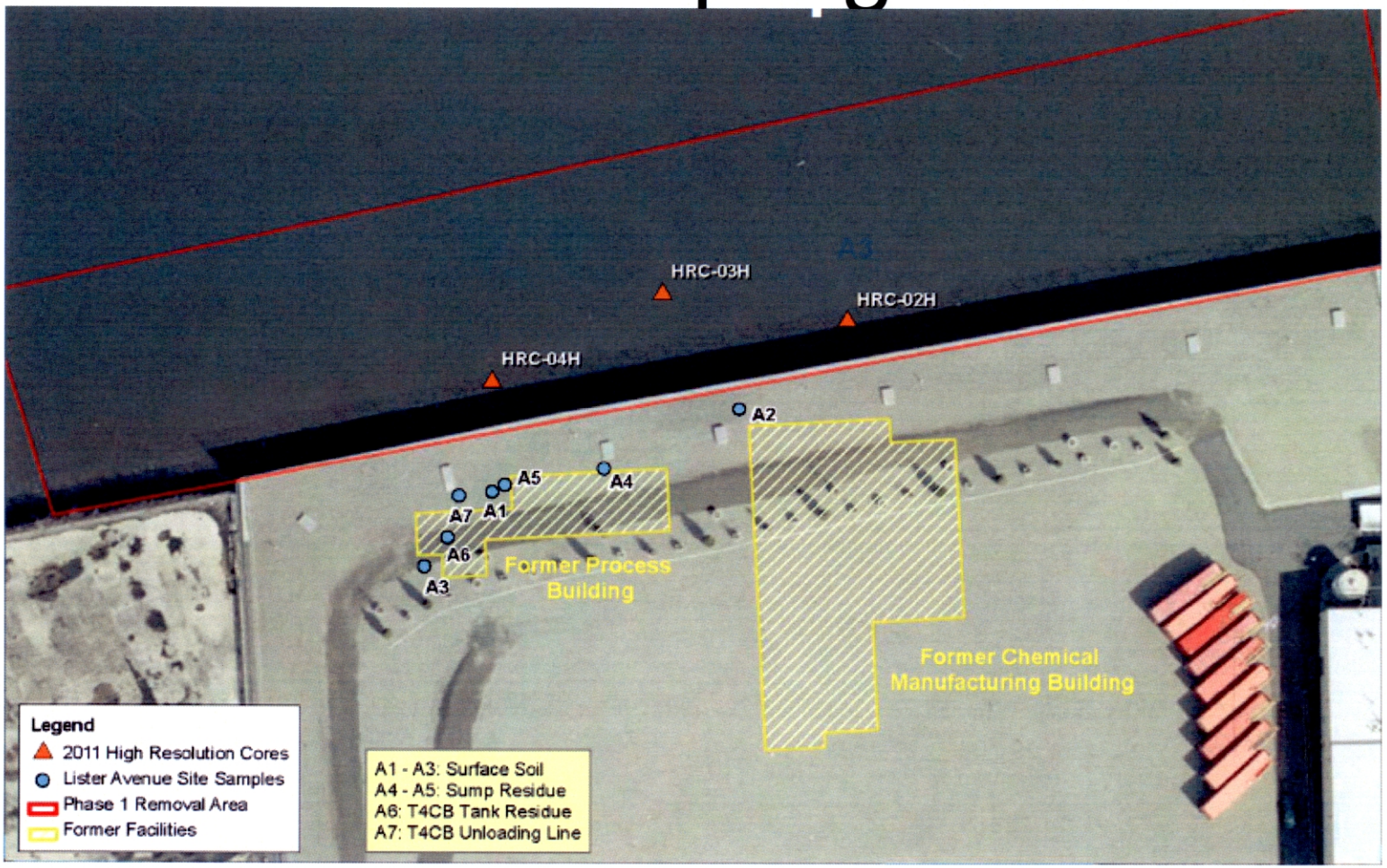
- Givaudan
  - Used between 38 to 44 M lb pre-purified pharmaceutical grade TCP feedstock (1947-1984) x 1 ppb (average concentration) = .038 lb to .044 lb of TCDD

- Conservatively, if one assumes both facilities used equal care in their prospective production processes and waste disposal, then the TCDD handled and available for potential release by Lister Avenue was approximately ***10,000 - 58,000*** times greater by weight than the total potential for release by Givaudan

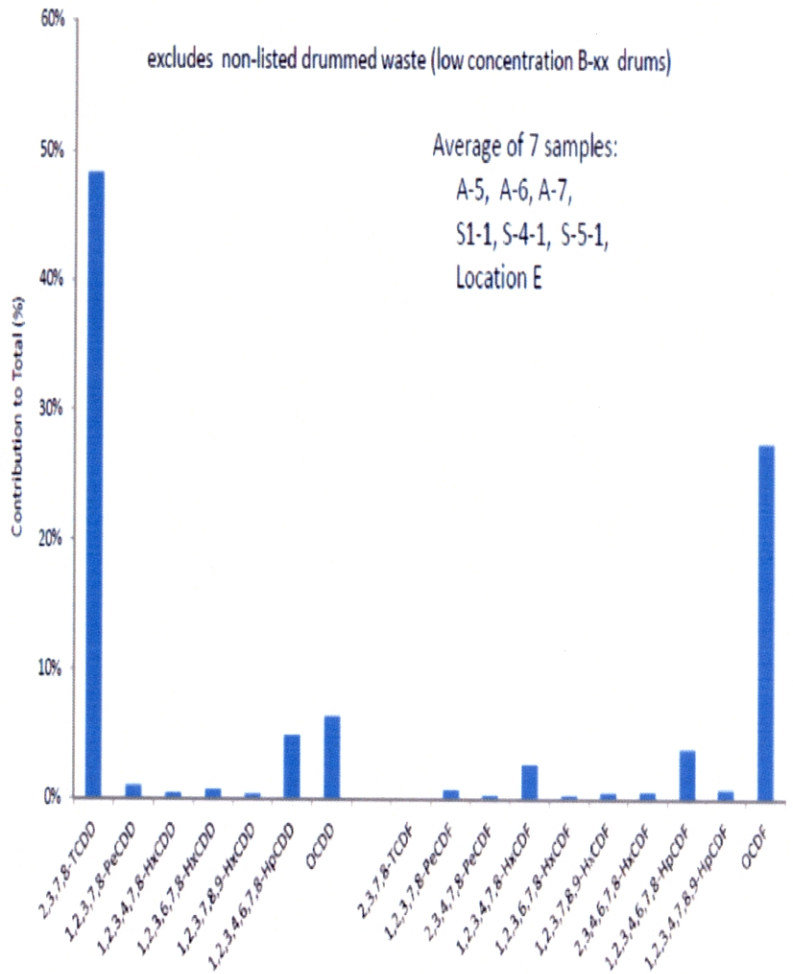
Source Identification and Chemical Fingerprinting

- There is adequate dioxin/furan data to identify the source of 2,3,7,8 TCDD contamination in the RM 10.9 sediments
  - Lister Upland Data
  - Lister Phase I Removal Area Data
  - RM 10.9 Data
  - FSI Data
  - Givaudan Upland Data
- 17 toxic dioxin/furan congeners are commonly used in source characterization of environmental samples[33]

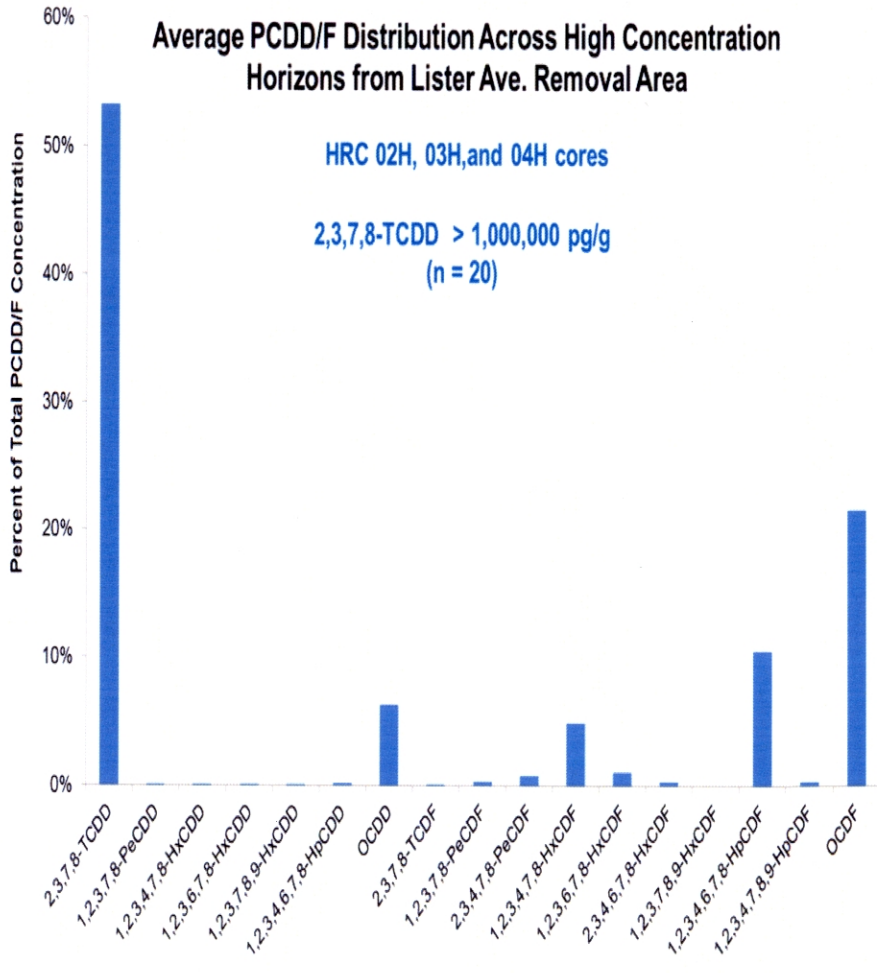
Lister Upland & Removal Area Sampling



Lister Fingerprint Comparison

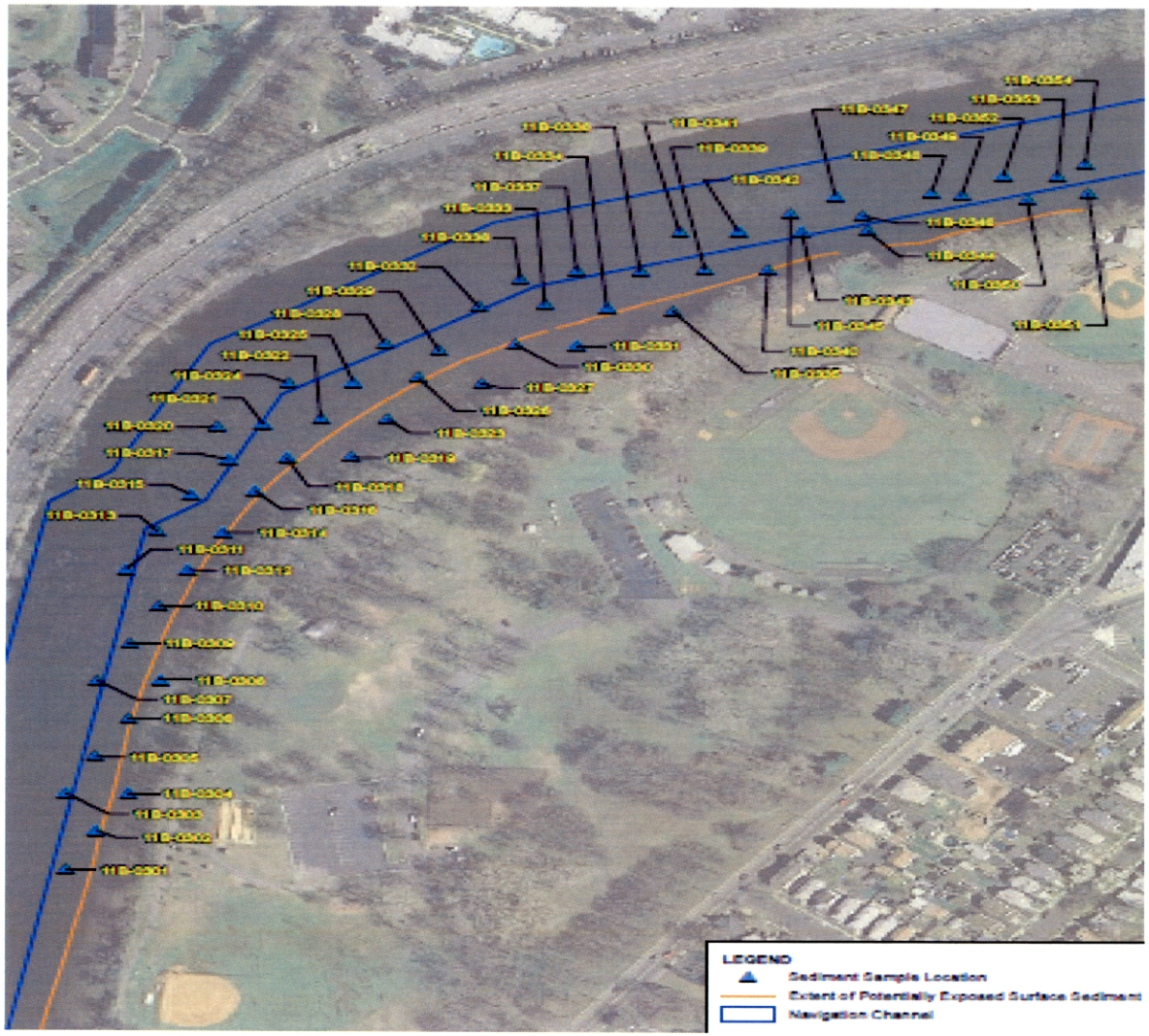


Lister Upland Fingerprint

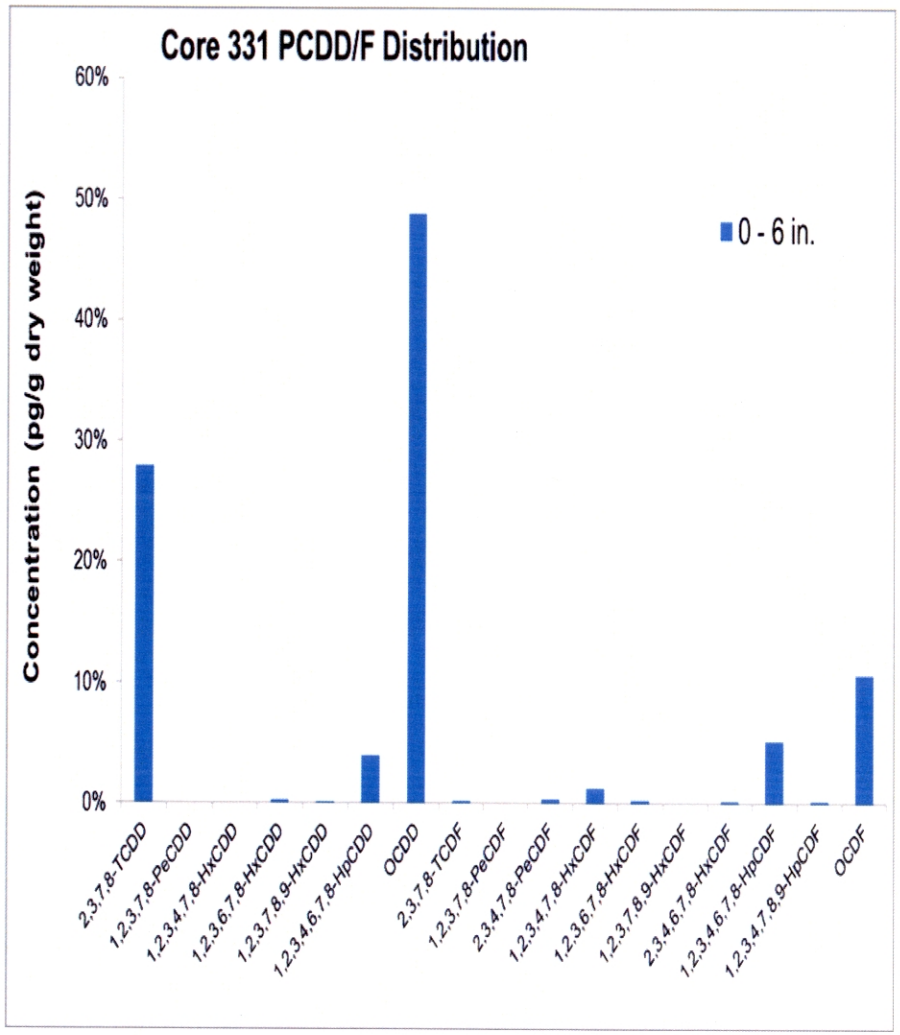


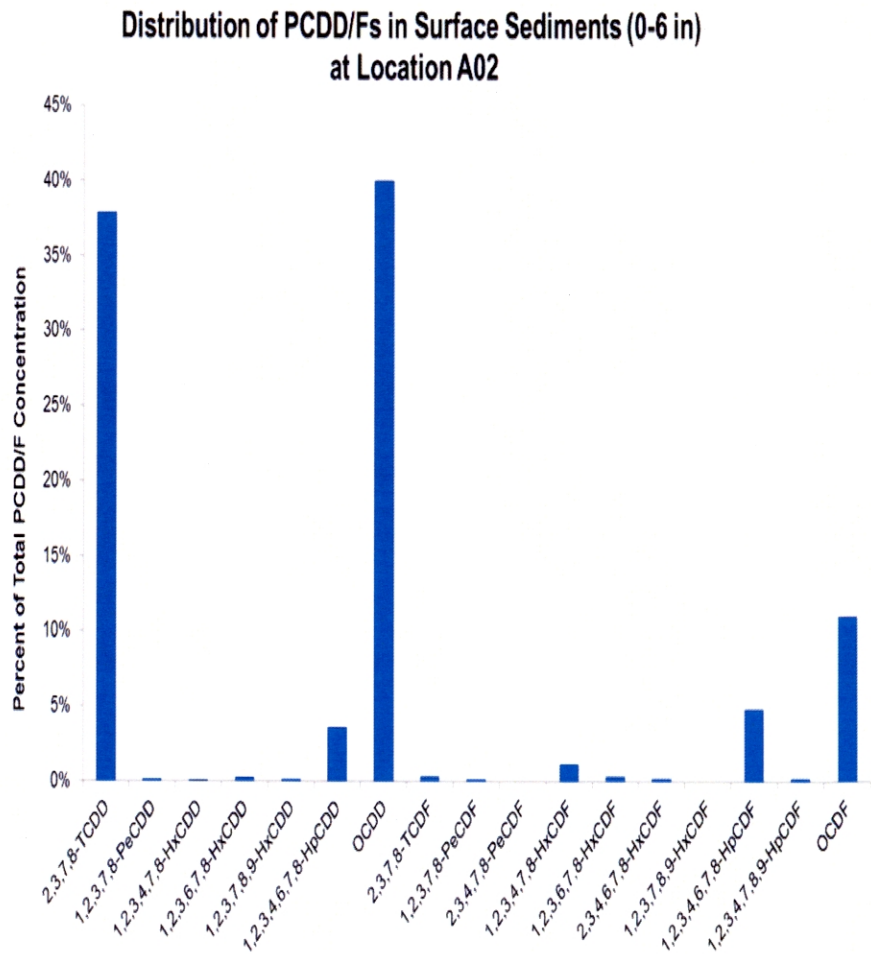
Lister Removal Fingerprint

RM 10.9 Sampling

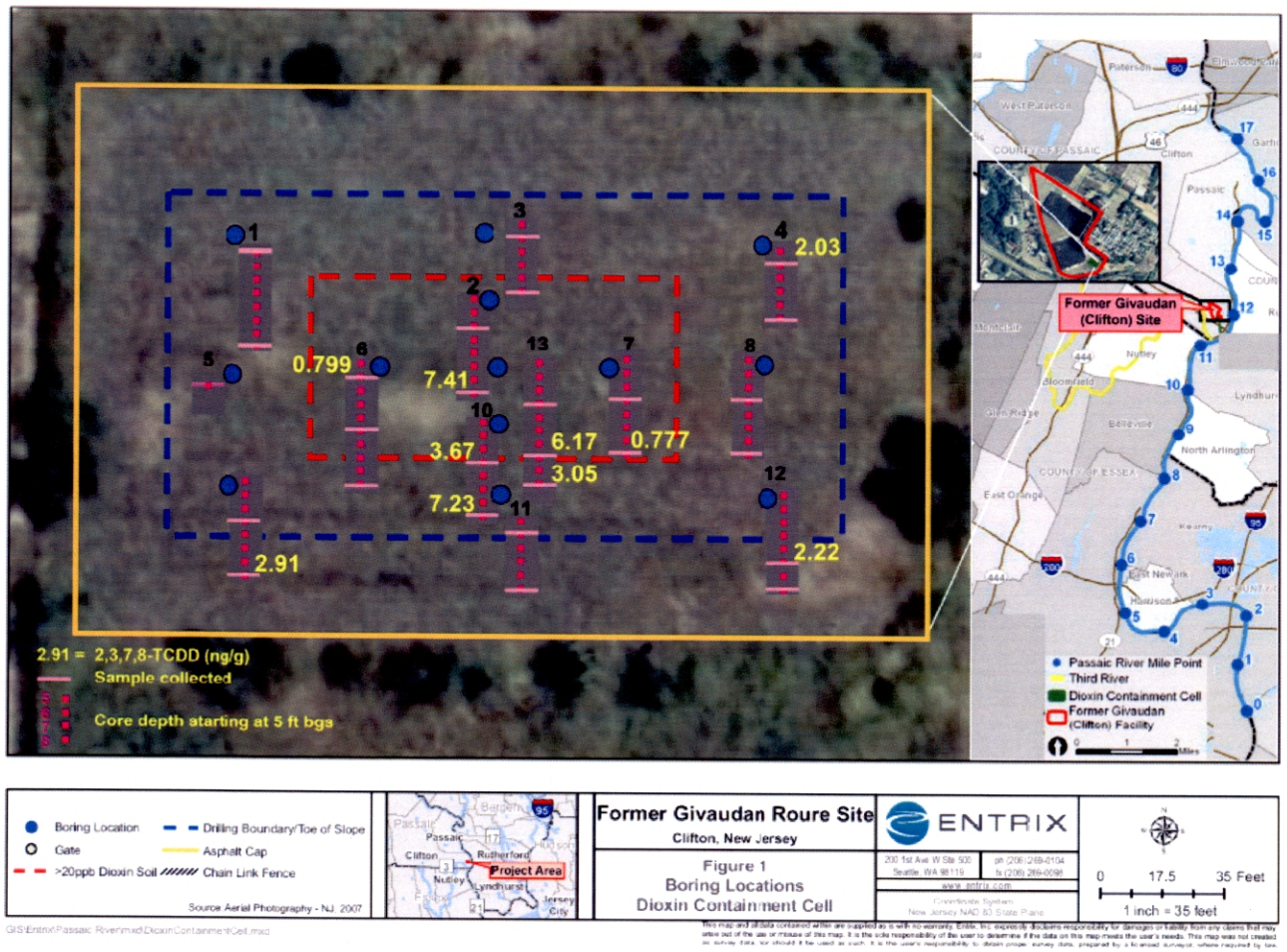


RM 10.9 Area Surface Fingerprint

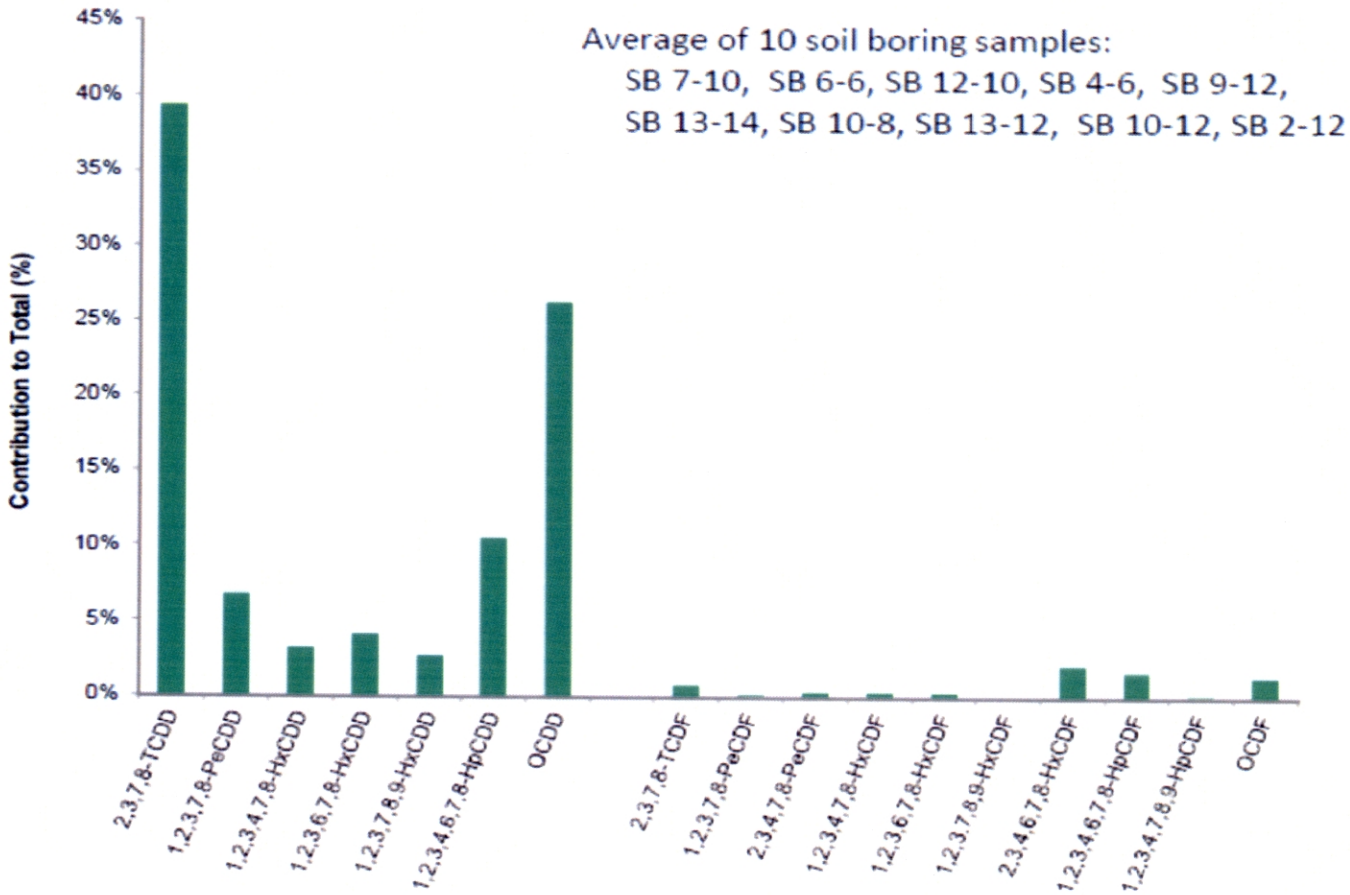




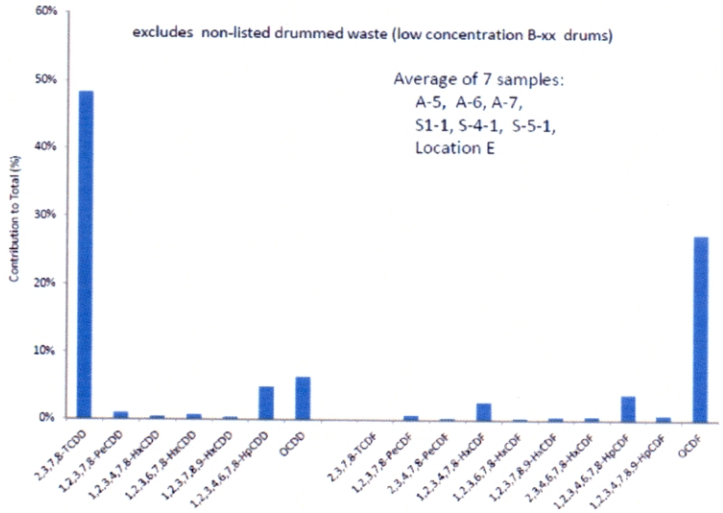
Givaudan Dioxin Cell Sampling



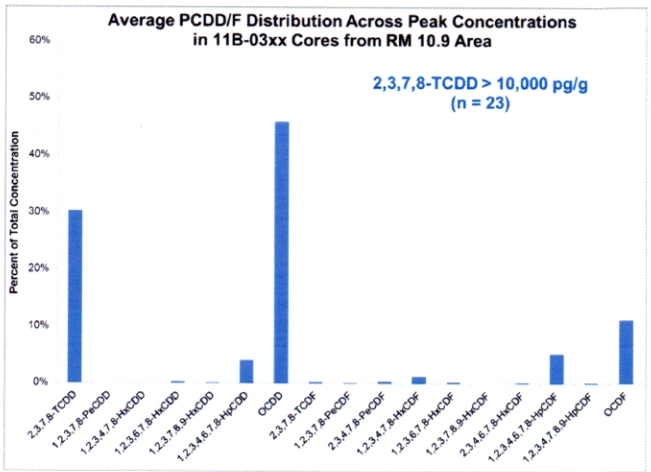
Clifton Upland Average



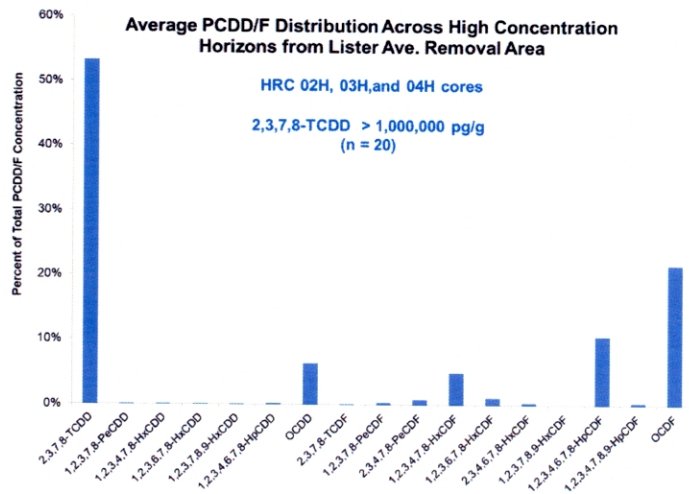
Fingerprint Comparisons



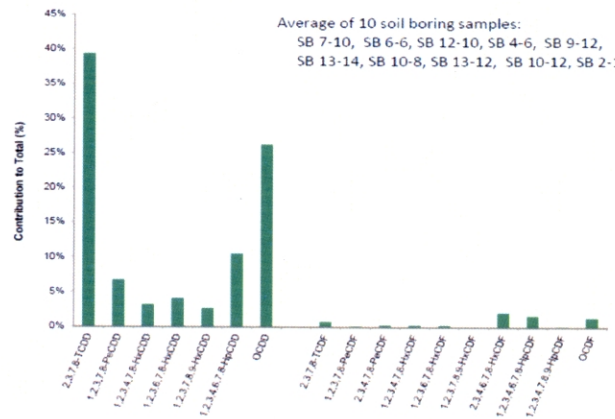
LISTER UPLAND



RM 10.9



LISTER PHASE I FOOTPRINT



CLIFTON UPLAND

Lister Avenue Dioxin Transport Throughout the LPRSA/NBC

- 20+ years of Direct Discharge/Disposal of TCDD to Passaic River
- Discharge of TCDD-Impacted Groundwater to LPR to 2000
- Salt Wedge Transport to Upper River (historic drought in early 1960's during Lister TCDD discharge period when sediment was laid down at RM 10.9)
- Strong Tidal Flows (to Upper River and to Newark Bay)
- Historical dredging in 1950s enabled greater upstream sediment transport and deposition coinciding with active dioxin and DDT discharges from Lister Site production period with the upper extent of the salt wedge[34]
- Other Physical Events Impacting Upstream Transport (Lister OU-1 work in 2000, ACE barge removal in April 1999, maintenance and pilot dredging projects, etc.)

Upriver Transport: Salt Wedge Intrusion Above RM 10

- Initial EPA hydrodynamic modeling runs show salt wedge intrusion to RM 13-14[35]
- Low flow conditions conducive to salt wedge intrusion to at least RM 10 have occurred about 20% to 25% of the time between 1955 and 2007[36]
- EPA model predicts salinity at RM 10 will exceed 5 pptr about 7% of the time and 0.5 pptr about 25% of the time[37]
- Daily tidal fluctuations and high TSS have been identified during recent PWCM by CPG in upper river[38]
- In-filling of Passaic over last half of 20th Century post-dredging has changed position of salt wedge, which is retreating toward NB[39]
- Twice Daily Tidal Exchange in System

Conclusions

- Lister is the Source of TCDD to the Newark Bay Complex and RM 10.9
- Lister Upland Fingerprint is Consistent with Lister Removal Area Fingerprint and RM 10.9 Sediments
- No Confirmed Offsite Discharges from Clifton Site and Clifton Upland Fingerprint is not Observed at RM 10.9 or Anywhere in LPRSA
- HCX Data Does Not Support Givaudan as the Source of 2,3,7,8 TCDD at RM 10.9

References

1 National Institute for Occupational Safety and Health (NIOSH) Dioxin Registry Report Diamond Alkali Company Newark, New Jersey (June 1986)

2 *Id.*

3 NIOSH Dioxin Registry Site Visit Report of Givaudan Corporation (March 1990).

4 *Id.*

5 Waste Streams From the Hexachlorophene Manufacturing Process (March 1984); Internal Givaudan Correspondence

6 National Institute for Occupational Safety and Health (NIOSH) Dioxin Registry Report Diamond Alkali Company Newark, New Jersey (June 1986)

7 *Id.*

8 *Diamond Shamrock Chemicals Co. v. Aetna Casualty & Surety Co. et al*, 258 N.J. Super. 167 (App. Div. 1992)

9 *Id.*

10 NIOSH Dioxin Registry Site Visit Report of Givaudan Corporation (March 1990)

11 *Id.*; *see also* Waste Streams From the Hexachlorophene Manufacturing Process (March 1984)

12 NIOSH Dioxin Registry Site Visit Report of Givaudan Corporation, March 1990; Givaudan internal correspondence

13 Diamond Alkali Inter-Office Correspondence (6/22/56)

14 Esposito, M.P., Tiernam, T.D. and Dryden, F. (1980) Dioxins Environmental Protection Agency Publication EPA 600/2-80-197

15 NIOSH Dioxin Registry Site Visit Report of Givaudan Corporation (March 1990)

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17 NIOSH Dioxin Registry Site Visit Report of Givaudan Corporation (March 1990)

18 Briefing document Givaudan Chemical Company Clifton, New Jersey (NUS 10/3/83)

19 In the Matter of Givaudan Corporation, Administrative Consent Order TCDD (3/5/87)

20 NJDEP approved TCDD Investigation Report, (ERM January 1991); Post-Excavation Sampling of 2,3,7,8 TCDD Impacted Soil (ERM 8/28/96); 2,3,7,8 TCDD Excavation and Disposal (ERM March 2000)

References

21 Remedial Action Report for On Site Containment of 2,3,7,8 TCDD Impacted Soils (ERM September 1997)
22 No Further Action Letter (NJDEP 2002)
23 *See* Response to Request for Information (Givaudan 2004); Employee interviews
24 Waste Streams From the Hexachlorophene Manufacturing Process (March 1984)
25 *Id.*
26 *Id.*
27 Battelle, 2003-2010
28 Bararas et al., 2010
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30 Viswanathan et al. "The Measurement and Significance of 1,2,4,5,7,8-Hexachloroxanthene in the Environment"
31 Remedial Investigation Centredale Manor Restoration Project Superfund Site North Providence, RI (Batetelle June 30, 2005)
32 Viswanathan and Kleopfer "The Presence of Hexachloroxanthene at Missouri Dioxin Sites" (1986)
33 EPA 600 P-03 2005 The Inventory of Sources and Env. Release of Dioxin-Like Compounds (EPA 3/4/05)
34 Chant et al. "The Shaping of An Estuarine Superfund Site: Roles of Evolving Dynamics and Geomorphology"
35 Lower Passaic River Restoration Project and Newark Bay Study Hydrodynamic Modeling Report (EPA 2008)
36 USGS river flow records from Little Falls, NJ
37 Lower Passaic River Restoration Project and Newark Bay Study Hydrodynamic Modeling Report (EPA 2008)
38 Cooperating Parties Group (2010)
39 Chant et al. "The Shaping of An Estuarine Superfund Site: Roles of Evolving Dynamics and Geomorphology"